

The present invention relates to a uni-directional fluid valve which may in particular be used as an exhalation valve for a filter mask. By a "filter mask" we mean a device adapted to be worn over the nose and mouth of a user and made from or incorporating a filter material to remove one or more unwanted components from the inspired air. To improve the comfort and efficiency of such devices it is common to provide a uni-directional exhalation valve on the mask which opens under the pressure differential consequent upon exhalation of the user to allow for a relatively unrestricted flow of exhalate out of the mask, but which closes under other conditions. Examples of valved filter masks are shown in GB-2072516, DE-4029939, U.S. Pat. No. 4,414,973, U.S. Pat. No. 4,838,262, U.S. Pat. No. 4,873,972, U.S. Pat. No. 4,934,362, U.S. Pat. No. 4,958,633, U.S. Pat. No. 4,974,586, U.S. Pat. No. 4,981,134 and U.S. Pat. No. 5,325,892.

A common type of exhalation valve comprises a circular diaphragm of e.g. silicone rubber and a cooperating circular valve seat surrounding the orifice which passes the user's exhalate. The diaphragm is clamped at its centre and marginal portions flex away from the seat when the user exhales. In another known type the diaphragm is in the form of a flexible flap which is attached to a cooperating seat structure at one end, that is to say in cantilever fashion, and flexes away from the rest of the seat when the user exhales. In the design of an exhalation valve it is important to maximise the cross-sectional area of the open orifice to allow free flow of exhalate through the valve, and also to minimise the differential air pressure required to open the valve (i.e. the valve "cracking" pressure). Centrally clamped diaphragm valves require a greater force to open them than cantilevered flap type valves of equivalent size because their available "lever arm" is less. Furthermore, the structure of a cantilevered flap type valve, when open, generally presents less of an obstruction to flow than the centrally clamped circular diaphragm type valve, or in other words imposes a smaller pressure drop for a given orifice size. A potential problem which must be addressed in the design of a cantilevered flap valve, however, lies in ensuring that the flap will remain closed in all orientations of the structure while it is not subject to an exhalatory pressure differential. That is to say, while in order to minimise the opening pressure differential of the valve it is desirable to employ a highly flexible flap of minimal thickness, the very flexibility of the flap may mean that if the valve is inverted in use (i.e. orientated with the seat lying above the flap), the flap may droop down from the seat when the user is not exhaling. This is clearly undesirable as it may open a leakage path into the mask for the contaminants which it is intended to exclude.

U.S. Pat. No. 5,325,892 discloses an exhalation valve 55 with a cantilevered flap in which the valve seat has a seal ridge which is curved in the longitudinal direction of the flap, the curvature corresponding to a deformation curve exhibited by the flap when it bends under its own weight (with no pressure differential). In other words the design of that valve recognises that the flap is unable to stay flat when the structure is inverted and matches the configuration of the seat to the curvature of the flap under that condition. 60

SUMMARY OF THE INVENTION

In accordance with the present invention a uni-directional fluid valve comprises a flexible flap and a cooperating valve

The flap 7 is positioned in the valve by a notch 13 at one end embracing a block 14 on housing member 5, and when the housing members are snapped together that end of the flap becomes trapped between the adjacent portion 9A of the seal ridge and a profiled block 15 upstanding from housing member 6. That is to say it is mounted in the valve in cantilever fashion. In its natural state, if the flap 7 is held horizontally at one end it will tend to bow longitudinally under the force of gravity, i.e. so that its opposite end droops down considerably from the plane of its fixed end. Both the block 15 and the facing portion 9A of seal ridge are, however, curved so as to impart to the flap a transversely arched configuration in the assembled valve, as seen particularly in FIGS. 4 and 5. In the illustrated embodiment this arching is accentuated for the central part of the flap by means of a second profiled block 16 upstanding from the housing member 6 in front of and to a slightly greater height than the block 15, although this is not essential in all embodiments of the invention. The arching of the flap stiffens it sufficiently to prevent it drooping away from any part of the seal ridge under zero pressure differential conditions, whatever the orientation of the valve. The preferred orientation of the valve is in fact with the outlet ports 10 directed with a downward component, as indicated in FIG. 1, so that the user's exhalate will not mist any associated eyewear, and if the user lowers his head the valve may become oriented with the flap 7 lying wholly below the housing member 5.

From FIG. 3 it will be seen that while the portion 9A of the seal ridge at the root end of the flap has a concave curvature the remainder 9B/9C of the ridge has a flat surface. From FIGS. 3 and 4 it will also be seen that the portion 9C of the seal ridge at the free end of the flap rises further from the plane of the member 5 than does the root end portion 9A.

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